6. Among high school students, enrollment in physical education remained unchanged during the first half of the 1990s. However, daily attendance in physical education declined from approximately 42 percent to 25 percent.
7. The percentage of high school students who were enrolled in physical education and who reported being physically active for at least 20 minutes in physical education classes declined from approximately 81 percent to 70 percent during the first half of this decade.
8. Only 19 percent of all high school students report being physically active for 20 minutes or more in daily physical education classes.

Research Needs

1. Develop methods to monitor patterns of regular, moderate physical activity.
2. Improve the validity and comparability of self-reported physical activity in national surveys.
3. Improve methods for identifying and tracking physical activity patterns among people with disabilities.
4. Routinely monitor the prevalence of physical activity among children under age 12.
5. Routinely monitor school policy requirements and of students' participation in physical education classes in elementary, middle, and high schools.

Appendix A: Sources of National Survey Data

National Health Interview Survey (NHIS)

This analysis used data from the 1991 NHIS to determine current prevalences of physical activity, and from 1985, 1990, and 1991 to determine physical activity trends, among U.S. adults aged 18 years and older (National Center for Health Statistics [NCHS] 1988, 1993; NCHS unpublished data). Since 1957, NCHS has been collecting year-round health data from a probability sample of the civilian, noninstitutionalized adult population of the United States. The design included oversampling of blacks to provide more precise estimates. For the 1985, 1990, and 1991 special supplement on health promotion and disease prevention, one adult aged 18 years or older was randomly selected from each family for participation from the total NHIS sample. Interviews were conducted in the homes; self-response was required for this special supplement, and callbacks were made as necessary. The sample was poststratified by the age, sex, and racial distribution of the U.S. population for the survey year and weighted to provide national estimates. The overall response rate for the NHIS has been 83 to 88 percent.

Behavioral Risk Factor Surveillance System (BRFSS)

The Centers for Disease Control and Prevention (CDC) initiated the BRFSS in 1981 to help states obtain prevalence estimates of health behaviors, including physical activity, that were associated with chronic disease. The BRFSS conducts monthly, year-round, telephone interviews of adults aged 18 years of age and older sampled by random-digit dialing (Remington et al. 1988; Siegel et al. 1991; Frazier, Franks, Sanderson 1992). Physical activity questions have been consistent since 1986, except for a minor change from 1986 to 1987. In 1994, the most recent survey available, 49 states and the District of Columbia participated. Only 25 states and the District of Columbia have participated continuously since 1986. For 1986–1991, sample sizes ranged from approximately 35,000 to 50,000, and response rates from 62 to 71 percent; for 1992, the sample size was 96,343, and the response rate 71 percent; for 1994, the sample size was 106,030, and the response rate

70 percent. For examination of trends, analysis was restricted to the 25 states and the District of Columbia, that had consistently participated from 1986 through 1994. For 1992 cross-sectional analyses, data were included from all 48 states that had participated that year and from the District of Columbia. For 1994 cross-sectional analyses, data were included from the 49 participating states and from the District of Columbia.

Third National Health and Nutrition Examination Survey (NHANES III)

NHANES III is the seventh in a series of national health examination surveys that began in the 1960s. The sample for NHANES III (NCHS 1994a) was selected from 81 counties across the United States. The survey period covered 1988–1994 and consisted of two phases of equal length and sample size. Both Phase I (1988–1991) and Phase II (1992–1994) used probability samples of the U.S. civilian noninstitutionalized population. Black and Mexican American populations were oversampled to obtain statistically reliable estimates for these minority groups. Phase II data were not available at the time this report was prepared. In Phase I, the selected population was 12,138 adults 18 years of age or older, of which 82 percent (9,901) underwent a home interview that included questions on physical activity. Participants in NHANES III also underwent a detailed medical examination in a mobile examination center. NHANES III data were weighted to the 1990 U.S. civilian noninstitutionalized population to provide national estimates.

Youth Risk Behavior Survey (YRBS)

The CDC developed the YRBS (Kolbe 1990; Kolbe, Kann, Collins 1993) to measure six categories of priority health-risk behaviors among adolescents: 1) behaviors that contribute to intentional and unintentional injuries; 2) tobacco use; 3) alcohol and other drug use; 4) sexual behaviors that result in unintended pregnancy and sexually transmitted diseases, including HIV infection; 5) unhealthy dietary behaviors; and 6) physical inactivity. Data were collected through national, state, and local school-based surveys of high school students in grades 9–12 during the spring of odd-numbered years and through a 1992 national household-based survey of young people aged 12–21 years. The 1991, 1993, and 1995 national school-based YRBS (Kann et al. 1993; CDC unpublished data) used three-stage cluster sample designs. The targeted population consisted of all public and private school students in grades 9–12 in the 50 states and the District of Columbia. Schools with substantial numbers of black and Hispanic students were sampled at relatively higher rates than all other schools.

Survey procedures were designed to protect student privacy and allow anonymous participation. The questionnaire was administered in the classroom by trained data collectors, and students recorded their responses on answer sheets designed for scanning by computer. The school response rates ranged from 70 to 78 percent, and the student response rate ranged from 86 to 90 percent. The total number of students who completed questionnaires was 12,272 in 1991, 16,296 in 1993, and 10,904 in 1995. The data were weighted to account for nonresponse and for oversampling of black and Hispanic students.

National Health Interview Survey-Youth Risk Behavior Survey (NHIS-YRBS)

To provide more information about risk behaviors among young people, including those who do not attend school, the CDC added a youth risk behavior survey to the 1992 National Health Interview Survey (CDC 1993; NCHS 1994b). The survey was conducted as a follow-back from April 1992 through March 1993 among 12- through 21-year-olds from a national probability sample of households. School-aged youths not attending school were oversampled. NHIS-YRBS interviews were completed for 10,645 young people, representing an overall response rate of 74 percent.

The questionnaire for this survey was administered through individual portable cassette players with earphones. After listening to questions, respondents marked their answers on standardized answer sheets. This methodology was designed to help young people with reading problems complete the survey and to enhance confidentiality during household administration. Data from this report were weighted to represent the U.S. population of 12- through 21-year-olds.

Appendix B: Measures of Physical Activity in Population Surveys

There is no uniformly accepted method of assessing physical activity. Various methods have been used (Stephens 1989); unfortunately, estimates of physical activity are highly dependent on the survey instrument. The specific problems associated with using national surveillance systems—such as those employed here—to monitor leisure-time physical activity have been reviewed previously (Caspersen, Merritt, Stephens 1994).

All of the population surveys cited have employed a short-term recall of the frequency, and in some cases the duration and intensity, of activities that either were listed for the participant to respond to or were probed for in an open-ended manner. The validity of these questions is not rigorously established. Estimates of prevalence of participation are influenced by sampling errors, seasons covered, and the number and wording of such questions; generally, the more activities offered, the more likely a participant will report some activity. Besides defining participation in any activity or in individual activities, many researchers have found it useful to define summary indices of regular participation in vigorous activity or moderate activity (Caspersen 1994; Caspersen, Merritt, Stephens 1994). These summary measures often require assumptions about the intensity of reported activities and the frequency and duration of physical activity required for health benefits.

National Health Interview Survey (NHIS)

Participants in the NHIS were asked in a standardized interview whether they did any of 22 exercises, sports, or physically active hobbies in the previous 2 weeks: walking for exercise, jogging or running, hiking, gardening or yard work, aerobics or aerobic dancing, other dancing, calisthenics or general exercise, golf, tennis, bowling, bicycling, swimming or water exercises, yoga, weight lifting or training, basketball, baseball or softball, football, soccer, volleyball, handball or racquetball or squash, skating, and skiing (National Center for Health Statistics [NCHS] 1992). They were also asked, in an open-ended fashion, for other unmentioned activities performed in the previous 2 weeks. For each activity, the interviewer asked the number of times, the average minutes duration, and the perceived degree to which heart rate or breathing increased (i.e., none or small, moderate, or large).

The physical activity patterns were scored by using data for frequency and duration derived directly from the NHIS. To estimate the regular, vigorous physical activity pattern, a previously proposed convention was followed (Caspersen, Pollard, Pratt 1987). One of two sex-specific regression equations was used to estimate the respondent's maximum cardiorespiratory capacity (expressed in metabolic equivalents [METs]) (Jones and Campbell 1982): [60–0.55 • age (years)]/3.5 for men, and [48–0.37 • age (years)]/3.5 for women. One MET is the value of resting oxygen uptake relative to total body mass and is generally ascribed the value of 3.5 milliliters of oxygen per kilogram of body mass per minute (for example, 3 METs equals 3 times the resting level; walking at 3 miles per hour on a level surface would be at about that intensity). Individual activity intensity was based on reported values (Taylor et al. 1978; Folsom et al. 1985; Stephens and Craig 1989).

The final activity intensity code for a specific activity was found by selecting one of three conditions corresponding to the perceived level of effort associated with usual participation. The perceived effort was associated with none or small, moderate, or large perceived increases in heart rate or breathing. For example, the activity intensity code for three levels of volleyball participation would be 5, 6, and 8 METs as the perceived effort progressed from none or small to large increases in heart rate or breathing. In some cases, a single intensity code was averaged for several types of activity participation that were not distinguished in the NHIS. This averaging was done for such activities as golf, calisthenics or general exercise, swimming or water exercises, skating, and skiing. To determine if an activity would qualify a person to meet the intensity criterion of vigorous physical activity, each intensity code had to meet or exceed 50 percent of the estimated age- and sex-specific maximum cardiorespiratory capacity.

For this report, three patterns of leisure-time activity were defined (Caspersen 1994):

- *No physical activity*: No reported activity during the previous 2 weeks.
- *Regular, sustained activity*: ≥ 5 times per week and ≥ 30 minutes per occasion of physical activity of any type and at any intensity.
- *Regular, vigorous activity*: ≥ 3 times per week and ≥ 20 minutes per occasion of physical activity involving rhythmic contractions of large muscle groups (e.g., jogging or running, racquet sports, competitive group sports) performed at ≥ 50 percent of estimated age- and sex-specific maximum cardiorespiratory capacity.

Behavioral Risk Factor Surveillance System (BRFSS)

The BRFSS questionnaire first asks, "During the past month, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" If yes, participants were asked to identify their two most common physical activities and to indicate the frequency in the previous month and duration per occasion (Caspersen and Powell 1986; Caspersen and Merritt 1995). If running, jogging, walking, or swimming were mentioned, participants were also asked the usual distance covered.

The reported frequency and duration of activity were used for scoring. Intensity of physical activity was assigned by using the same intensity codes as the NHIS, and a correction procedure (explained later in this section) based on speeds of activities was used to create intensity codes for walking, running/jogging, and swimming (Caspersen and Powell 1986; Caspersen and Merritt 1995).

The estimate of speed was made by dividing the self-reported distance in miles by the duration in hours. The speed estimate was entered into specific regression equations to refine the intensity code for these four activities, because the application of a single intensity code is likely to underestimate or overestimate the intensity. Based on previously published formulae (American College of Sports Medicine 1988), five equations were constructed for predicting metabolic intensity of walking, jogging, and running at various calculated speeds:

Equation 1 METs = 1.80
(Speeds < 0.93 mph)

Equation 2 METs = 0.72 x mph + 1.13
(Speeds ≥ 0.93 but < 3.75 mph)

Equation 3 METs = 3.76 x mph - 10.20
(Speeds ≥ 3.75 but < 5.00 mph)

Equation 4 METs = 1.53 x mph + 1.03
(Speeds ≥ 5.00 but < 12.00 mph)

Equation 5 METs = 7.0 or 8.0
(Speeds ≥ 12.00 mph)

Below 0.93 mph, an intensity code of 1.8 METs (Equation 1) was used, to be consistent with Montoye's intensity code for residual activities like those associated with slow movements (Montoye 1975). Equation 2 is extrapolated to include speeds as slow as 0.93 mph—the point at which metabolic cost was set at 1.8 METs. Persons whose calculated speeds fell between 0.93 and 12.0 mph were assigned an intensity from equations 2, 3, or 4, regardless of whether they said they walked, jogged, or ran. Equation 3 was created by simply connecting with a straight line the last point of equation 2 and the first point of equation 4. This interpolation was seen as a reasonable way to determine intensity within the range of speed where walking or jogging might equally occur. This assignment method was considered to be more objective, specific, and generally conservative than assigning an intensity code based solely on the self-reported type of activity performed. Thus, as a correction procedure for self-reported speeds judged likely to be erroneously high, an intensity of 2.5 METs was assigned for walking speeds above 5.0 mph, 7.0 METs for jogging speeds above 12.0 mph, and 8.0 METs for running speeds above 12.0 mph.

Another set of regression equations predicted metabolic intensity from swimming velocity:

Equation 6 METs = 1.80
(Speeds < 0.26 mph)

Equation 7 METs = 4.19 x mph - 0.69
(Speeds ≥ 0.26 but < 2.11 mph)

Equation 8 METs = 8.81 x mph - 9.08
(Speeds ≥ 2.11 but < 3.12 mph)

Equation 9 METs = 5.50
(Speeds ≥ 3.12 mph)

These equations were set forth in a Canadian monograph of energy expenditure for recreational activities (Groupe d'étude de Kino-Quebec sur le système de quantification de la dépense énergétique 1984). However, swimming speeds up to 3.12 mph for the crawl and backstroke, in the derivation of equations 7 and 8, were obtained from published research (Holmer 1974a; Holmer 1974b; Passmore and Durnin 1955). Default intensity codes were assigned as follows: 1.8 METs for swimming speeds less than 0.26 mph, and 5.5 METs for velocities greater than 3.12 mph, because such speeds are improbable and likely reflected errors in self-report.

Definitions used for leisure-time physical activity were the same as those described for the NHIS earlier in this appendix.

Third National Health and Nutrition Examination Survey (NHANES III)

The NHANES III questions that addressed leisure-time physical activity (NCHS 1994a) were adapted from the NHIS. Participants first were asked how often they had walked a mile or more at one time in the previous month. They were then asked to specify their frequency of leisure-time physical activity during the previous month for the following eight activities: jogging or running, riding a bicycle or an exercise bicycle, swimming, aerobics or aerobic dancing, other dancing, calisthenics or exercises, gardening or yard work, and weight lifting. An open-ended question asked for information on up to four physical activities not previously listed. Information on duration of physical activity was not collected. Northern sites selected for NHANES III tended to be surveyed in warm rather than cold months, which might have led to a greater prevalence of reported physical activity than would otherwise be obtained from a year-round survey. No physical activity was defined as no reported leisure-time physical activity in the previous month. Regular, sustained activity and regular, vigorous activity were not defined for NHANES III because of the lack of information on activity duration.

Youth Risk Behavior Survey (YRBS)

In the YRBS questionnaire (Kann et al. 1993), students in grades 9–12 were asked eight questions about physical activity. The question on vigorous physical activity asked, "On how many of the past 7 days did you exercise or participate in sports activities for at least 20 minutes that made you sweat and breathe hard, such as basketball, jogging, fast dancing, swimming laps, tennis, fast bicycling, or similar aerobic activities?" The questionnaire asked separately about the frequency of three specific activities in the previous 7 days: 1) stretching exercises, such as toe touching, knee bending, or leg stretching; 2) exercises to strengthen or tone the muscles, such as push-ups, sit-ups, or weight lifting; and 3) walking or bicycling for at least 30 minutes at a time. Participants were asked about physical education, "In an average week when you are in school, on how many days do you go to physical education (PE) classes?" and "During an average physical education (PE) class, how many minutes do you spend actually exercising or playing sports?" Students were also asked, "During the past 12 months, on how many sports teams run by your school did you play? (Do not include PE classes.)" and "During the past 12 months, on how many sports teams run by organizations outside of your school did you play?"

National Health Interview Survey-Youth Risk Behavior Survey (NHIS-YRBS)

The NHIS-YRBS questionnaire (NCHS 1994b) ascertained the frequency of vigorous physical activity among U.S. young people aged 12–21 years by asking, "On how many of the past 7 days did you exercise or take part in sports that made you sweat and breathe hard, such as basketball, jogging, fast dancing, swimming laps, tennis, fast bicycling, or other aerobic activities?" Ten other questions asked about the previous 7 days' frequency of participating in the following specific activities: 1) stretching exercises, such as toe touching, knee bending, or leg stretching; 2) exercises to strengthen or tone muscles such as push-ups, sit-ups, or weight lifting; 3) house cleaning or yard work for ≥ 30 minutes at a time; 4) walking or bicycling for ≥ 30 minutes at a time; 5) baseball, softball, or Frisbee®[1]; 6) basketball, football, or soccer; 7) roller skating, ice skating, skiing, or skateboarding; 8) running, jogging, or swimming for exercise; 9) tennis, racquetball, or squash; and 10) aerobics or dance. Questions about duration and intensity were not asked.

[1]Use of trade names is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services.

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CHAPTER 6

UNDERSTANDING AND PROMOTING PHYSICAL ACTIVITY

Contents

CHAPTER 6

UNDERSTANDING AND PROMOTING PHYSICAL ACTIVITY

Introduction

As the benefits of moderate, regular physical activity have become more widely recognized, the need has increased for interventions that can promote this healthful behavior. Because theories and models of human behavior can guide the development and refinement of intervention efforts, this chapter first briefly examines elements of behavioral and social science theories and models that have been used to guide much of the research on physical activity. First for adults, then for children and adolescents, the chapter reviews factors influencing physical activity and describes interventions that have sought to improve participation in regular physical activity among these two age groups. To put in perspective the problem of increasing individual participation in physical activity, the chapter next examines societal barriers to engaging in physical activity and describes existing resources that can increase opportunities for activity. The chapter concludes with a summary of what is known about determinant and intervention research on physical activity and makes recommendations for research and practice.

Theories and Models Used in Behavioral and Social Science Research on Physical Activity

Numerous theories and models have been used in behavioral and social science research on physical activity. These approaches vary in their applicability to physical activity research. Some models and theories were designed primarily as guides to understanding behavior, not as guides for designing interventions. Others were specifically constructed with a view toward developing interventions, and some of these have been applied extensively in intervention research as well. Because most were developed to explain the behavior of individuals and to guide individual and small-group intervention programs, these models and theories may have only limited application to understanding the behavior of populations or designing communitywide interventions. Key elements most frequently used in the behavioral and social science research on physical activity are described below and summarized in Table 6-1.

Learning Theories

Learning theories emphasize that learning a new, complex pattern of behavior, like changing from a sedentary to an active lifestyle, normally requires modifying many of the small behaviors that compose an overall complex behavior (Skinner 1953). Principles of behavior modification suggest that a complex-pattern behavior, such as walking continuously for 30 minutes daily, can be learned by first breaking it down into smaller segments (e.g., walking for 10 minutes daily). Behaviors that are steps toward a final goal need to be reinforced and established first, with rewards given for partial accomplishment if necessary. Incremental increases, such as adding 5 minutes to the daily walking each week, are then made as the complex pattern of behaviors is "shaped" toward the targeted goal. A further complication to the change process is that new patterns of physical activity behavior must replace or compete with former patterns of inactive behaviors that are often satisfying (e.g., watching television), habitual behaviors (e.g., parking close to the door), or behaviors cued by the environment (e.g., the presence of an elevator).

Reinforcement describes the consequences that motivate individuals either to continue or discontinue a behavior (Skinner 1953; Bandura 1986).

Table 6-1. Summary of theories and models used in physical activity research

Theory/model	Level	Key concepts
Classic learning theories	Individual	Reinforcement Cues Shaping
Health belief model	Individual	Perceived susceptibility Perceived severity Perceived benefits Perceived barriers Cues to action Self-efficacy
Transtheoretical model	Individual	Precontemplation Contemplation Preparation Action Maintenance
Relapse prevention	Individual	Skills training Cognitive reframing Lifestyle rebalancing
Social cognitive theory	Interpersonal	Reciprocal determinism Behavioral capability Self-efficacy Outcome expectations Observational learning Reinforcement
Theory of planned behavior	Interpersonal	Attitude toward the behavior Outcome expectations Value of outcome expectations Subjective norm Beliefs of others Motive to comply with others Perceived behavioral control
Social support	Interpersonal	Instrumental support Informational support Emotional support Appraisal support
Ecological perspective	Environmental	Multiple levels of influence Intrapersonal Interpersonal Institutional Community Public policy

Source: Adapted from Glanz K and Rimer BK. *Theory at-a-glance: a guide for health promotion practice*, U.S. Department of Health and Human Services, 1995.

Most behaviors, including physical activity, are learned and maintained under fairly complex schedules of reinforcement and anticipated future rewards. Future rewards or incentives may include physical consequences (e.g., looking better), extrinsic rewards (e.g., receiving praise and encouragement from others, receiving a T-shirt), and intrinsic rewards (e.g., experiencing a feeling of accomplishment or gratification from attaining a personal milestone). It is important to note that although providing praise, encouragement, and other extrinsic rewards may help people adopt positive lifestyle behaviors, such external reinforcement may not be reliable in sustaining long-term change (Glanz and Rimer 1995).

Health Belief Model

The health belief model stipulates that a person's health-related behavior depends on the person's perception of four critical areas: the severity of a potential illness, the person's susceptibility to that illness, the benefits of taking a preventive action, and the barriers to taking that action (Hochbaum 1958; Rosenstock 1960, 1966). The model also incorporates cues to action (e.g., leaving a written reminder to oneself to walk) as important elements in eliciting or maintaining patterns of behavior (Becker 1974). The construct of self-efficacy, or a person's confidence in his or her ability to successfully perform an action (discussed in more detail later in this chapter), has been added to the model (Rosenstock 1990), perhaps allowing it to better account for habitual behaviors, such as a physically active lifestyle.

Transtheoretical Model

In this model, behavior change has been conceptualized as a five-stage process or continuum related to a person's readiness to change: precontemplation, contemplation, preparation, action, and maintenance (Prochaska and DiClemente 1982, 1984). People are thought to progress through these stages at varying rates, often moving back and forth along the continuum a number of times before attaining the goal of maintenance. Therefore, the stages of change are better described as spiraling or cyclical rather than linear (Prochaska, DiClemente, Norcross 1992). In this model, people use different processes of change as they move from one stage of change to another. Efficient self-change thus depends on doing the right thing (processes) at the right time (stages) (Prochaska, DiClemente, Norcross 1992). According to this theory, tailoring interventions to match a person's readiness or stage of change is essential (Marcus and Owen 1992). For example, for people who are not yet contemplating becoming more active, encouraging a step-by-step movement along the continuum of change may be more effective than encouraging them to move directly into action (Marcus, Banspach, et al. 1992).

Relapse Prevention Model

Some researchers have used concepts of relapse prevention (Marlatt and Gordon 1985) to help new exercisers anticipate problems with adherence. Factors that contribute to relapse include negative emotional or physiologic states, limited coping skills, social pressure, interpersonal conflict, limited social support, low motivation, high-risk situations, and stress (Brownell et al. 1986; Marlatt and George 1990). Principles of relapse prevention include identifying high-risk situations for relapse (e.g., change in season) and developing appropriate solutions (e.g., finding a place to walk inside during the winter). Helping people distinguish between a lapse (e.g., a few days of not participating in their planned activity) and a relapse (e.g., an extended period of not participating) is thought to improve adherence (Dishman 1991; Marcus and Stanton 1993).

Theory of Reasoned Action and Theory of Planned Behavior

The theory of reasoned action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980) states that individual performance of a given behavior is primarily determined by a person's intention to perform that behavior. This intention is determined by two major factors: the person's attitude toward the behavior (i.e., beliefs about the outcomes of the behavior and the value of these outcomes) and the influence of the person's social environment or subjective norm (i.e., beliefs about what other people think the person should do, as well as the person's motivation to comply with the opinions of others). The theory of planned behavior (Ajzen 1985, 1988) adds to the theory of reasoned action the concept of perceived control over the opportunities, resources, and skills necessary to perform a behavior. Ajzen's concept of

perceived behavioral control is similar to Bandura's (1977a) concept of self-efficacy—a person's perception of his or her ability to perform the behavior (Ajzen 1985, 1988). Perceived behavioral control over opportunities, resources, and skills necessary to perform a behavior is believed to be a critical aspect of behavior change processes.

Social Learning/Social Cognitive Theory

Social learning theory (Bandura 1977b), later renamed social cognitive theory (Bandura 1986), proposes that behavior change is affected by environmental influences, personal factors, and attributes of the behavior itself (Bandura 1977b). Each may affect or be affected by either of the other two. A central tenet of social cognitive theory is the concept of self-efficacy. A person must believe in his or her capability to perform the behavior (i.e., the person must possess self-efficacy) and must perceive an incentive to do so (i.e., the person's positive expectations from performing the behavior must outweigh the negative expectations). Additionally, a person must value the outcomes or consequences that he or she believes will occur as a result of performing a specific behavior or action. Outcomes may be classified as having immediate benefits (e.g., feeling energized following physical activity) or long-term benefits (e.g., experiencing improvements in cardiovascular health as a result of physical activity). But because these expected outcomes are filtered through a person's expectations or perceptions of being able to perform the behavior in the first place, self-efficacy is believed to be the single most important characteristic that determines a person's behavior change (Bandura 1986).

Self-efficacy can be increased in several ways, among them by providing clear instructions, providing the opportunity for skill development or training, and modeling the desired behavior. To be effective, models must evoke trust, admiration, and respect from the observer; models must not, however, appear to represent a level of behavior that the observer is unable to visualize attaining (Bandura 1986).

Social Support

Often associated with health behaviors such as physical activity, social support is frequently used in behavioral and social research. There is, however, considerable variation in how social support is conceptualized and measured (Israel and Schurman 1990). Social support for physical activity can be instrumental, as in giving a nondriver a ride to an exercise class; informational, as in telling someone about a walking program in the neighborhood; emotional, as in calling to see how someone is faring with a new walking program; or appraising, as in providing feedback and reinforcement in learning a new skill (Israel and Schurman 1990). Sources of support for physical activity include family members, friends, neighbors, co-workers, and exercise program leaders and participants.

Ecological Approaches

A criticism of most theories and models of behavior change is that they emphasize individual behavior change processes and pay little attention to sociocultural and physical environmental influences on behavior (McLeroy et al. 1988). Recently, interest has developed in ecological approaches to increasing participation in physical activity (McLeroy et al. 1988; CDC 1988; Stokols 1992). These approaches place the creation of supportive environments on a par with the development of personal skills and the reorientation of health services. Stokols (1992) and Simons-Morton and colleagues (CDC 1988; Simons-Morton, Simons-Morton, et al. 1988) have illustrated this concept of a health-promoting environment by describing how physical activity could be promoted by establishing environmental supports, such as bike paths, parks, and incentives to encourage walking or bicycling to work.

An underlying theme of ecological perspectives is that the most effective interventions occur on multiple levels. McLeroy and colleagues (1988), for example, have proposed a model that encompasses several levels of influences on health behaviors: intrapersonal factors, interpersonal and group factors, institutional factors, community factors, and public policy. Similarly, a model advanced by Simons-Morton and colleagues (CDC 1988) has three levels (individual, organizational, and governmental) in four settings (schools, worksites, health care institutions, and communities). Interventions that simultaneously influence these multiple levels and multiple settings may be expected to lead to greater and longer-lasting changes and maintenance of existing health-promoting habits. This is a promising area for

the design of future intervention research to promote physical activity.

Summary

Some similarities can be noted among the behavioral and social science theories and models used to understand and enhance health behaviors such as physical activity. Many of the theoretical approaches highlight the role of the perceived outcomes of behavior, although different terms are used for this construct, including perceived benefits and barriers (health belief model) and outcome expectations (social cognitive theory and theory of planned behavior) (Table 6-1). Several approaches also emphasize the influence of perceptions of control over behavior; this influence is given labels such as self-efficacy (health belief model, social cognitive theory) and perceived behavioral control (theory of planned behavior). Other theories and models feature the role of social influences, as in the concepts of observational learning (social cognitive theory), perceived norm (theory of reasoned action and theory of planned behavior), social support, and interpersonal influences (ecological perspective). Most of the theories and models, however, do not address the influence of the environment on health behavior.

Behavioral Research on Physical Activity among Adults

Behavioral research in this area includes studies on both the factors influencing physical activity among adults (determinants research) and the effectiveness of strategies and programs to increase this behavior (interventions research). Although many of the key concepts presented in the preceding section are featured in both types of research presented here, neither area is limited to those concepts only.

Factors Influencing Physical Activity among Adults

Research on the determinants of physical activity identifies those factors associated with, or predictive of, this behavior. This section reviews determinants studies in which the measured outcome was overall physical activity, adherence to or continued participation in structured physical activity programs, or movement from one stage of change to another (e.g., from contemplation to preparation). The section does not review studies in which the outcome measured was an intermediate measure of physical activity (e.g., intentions concerning future participation in physical activity). Although researchers have studied a wide array of potential influences on physical activity among adults, the section focuses on factors that can be modified, such as self-efficacy and social support, rather than on factors that cannot be changed, such as age, sex, and race/ethnicity.

Modifiable Determinants

The modifiable determinants of adult physical activity include personal, interpersonal, and environmental factors (Table 6-1). Self-efficacy, a construct from social cognitive theory, has been consistently and positively associated with adult physical activity (Courneya and McAuley 1994; Desmond et al. 1993; Hofstetter et al. 1991; Yordy and Lent 1993), physical activity stage of change (Marcus, Eaton, et al. 1994; Marcus and Owen 1992; Marcus, Pinto, et al. 1994; Marcus, Selby, et al. 1992), and adherence to structured physical activity programs (DuCharme and Brawley 1995; Duncan and McAuley 1993; McAuley, Lox, Duncan 1993; Poag-DuCharme and Brawley 1993; Robertson and Keller 1992). The evidence is less conclusive, however, for the theory of planned behavior's construct of perceived behavioral control (Courneya 1995; Courneya and McAuley 1995; Godin et al. 1991, 1995; Godin, Valois, Lepage 1993; Kimiecik 1992; Yordy and Lent 1993).

Several studies have found no association between adult physical activity (whether physical activity, stage of change, or adherence) and either the health belief model's constructs of perceived benefits (Hofstetter et al. 1991; Mirotznik, Feldman, Stein 1995; Oldridge and Streiner 1990; Taggart and Connor 1995) and perceived barriers (Desmond et al. 1993; Godin et al. 1995; Neuberger et al. 1994; Oldridge and Streiner 1990; Taggart and Connor 1995) or the theory of reasoned action and theory of planned behavior's construct of attitude toward the behavior (Courneya and McAuley 1995; Godin, Valois, Lepage 1993; Hawkes and Holm 1993). Nonetheless, the cumulative body of evidence supports the conclusion that expectations of both positive (e.g., benefits) and negative (e.g., barriers) behavioral outcomes are associated with physical activity among adults. Expectation of positive outcomes or

perceived benefits of physical activity has been consistently and positively associated with adult physical activity (Ali and Twibell 1995; Neuberger et al. 1994), physical activity stage of change (Booth et al. 1993; Calfas et al. 1994; Eaton et al. 1993; Marcus, Eaton, et al. 1994; Marcus and Owen 1992; Marcus, Pinto, et al. 1994; Marcus, Rakowski, Rossi 1992), and adherence to structured physical activity programs (Lynch et al. 1992; Robertson and Keller 1992). Conversely, the construct of perceived barriers to physical activity has been negatively associated with adult physical activity (Ali and Twibell 1995; Dishman and Steinhardt 1990; Godin et al. 1991; Hofstetter et al. 1991; Horne 1994), physical activity stage of change (Calfas et al. 1994; Lee 1993; Marcus, Eaton, et al. 1994; Marcus and Owen 1992; Marcus, Pinto, et al. 1994; Marcus, Rakowski, Rossi 1992), and adherence to structured physical activity programs (Howze, Smith, DiGilio 1989; Mirotznik et al. 1995; Robertson and Keller 1992). Additionally, attitude toward the behavior (outcome expectations and their values) has been consistently and positively related to physical activity (Courneya and McAuley 1994; Dishman and Steinhardt 1990; Godin et al. 1987, 1991; Kimiecik 1992; Yordy and Lent 1993) and stage of change (Courneya 1995).

Social support from family and friends has been consistently and positively related to adult physical activity (Felton and Parsons 1994; Horne 1994; Minor and Brown 1993; Sallis, Hovell, Hofstetter 1992; Treiber et al. 1991), stage of change (Lee 1993), and adherence to structured exercise programs (Duncan and McAuley 1993; Elward, Larson, Wagner 1992). Behavioral intention, a construct from the theory of reasoned action and the theory of planned behavior, also has consistently been associated with adult physical activity (Courneya and McAuley 1994; Godin et al. 1987, 1991; Godin, Valois, Lepage 1993; Kimiecik 1992; Yordy and Lent 1993), stage of change (Courneya 1995), and adherence to structured exercise programs (Courneya and McAuley 1995; DuCharme and Brawley 1995). Conversely, the construct of subjective norm from these theories has been both positively associated (Courneya 1995; Godin et al. 1987, 1991; Hawkes and Holm 1993; Kimiecik 1992; Yordy and Lent 1993) and not associated (Courneya and McAuley 1995; Godin et al. 1995; Hofstetter et al. 1991) with adult physical activity, stage of change, and adherence to structured exercise programs.

There is also mixed evidence regarding the positive relationship between the health belief model's construct of perceived severity of diseases and either physical activity (Godin et al. 1991) or adherence to structured exercise programs (Lynch et al. 1992; Mirotznik, Feldman, Stein 1995; Oldridge and Streiner 1990; Robertson and Keller 1992). Additionally, that model's construct of perceived susceptibility to illness has been unrelated to adult adherence to structured exercise programs (Lynch et al. 1992; Mirotznik et al. 1995; Oldridge and Streiner 1990).

The cumulative body of determinants research consistently reveals that exercise enjoyment is a determinant that has been positively associated with adult physical activity (Courneya and McAuley 1994; Horne 1994; McAuley 1991), stage of change (Calfas et al. 1994), and adherence to structured exercise programs (Wilson et al. 1994). Conversely, there has been no relationship between locus of control beliefs (i.e., perceptions of personal control over health, fitness, or physical activity) and either adult physical activity (Ali and Twibell 1995; Burk and Kimiecik 1994; Dishman and Steinhardt 1990; Duffy and MacDonald 1990) or adherence to structured exercise programs (Lynch et al. 1992; Oldridge and Streiner 1990). Although previous physical activity during adulthood has been consistently related to physical activity among adults (Godin et al. 1987, 1993; Minor and Brown 1993; Sharpe and Connell 1992) and stage of change (Eaton et al. 1993), history of physical activity during youth has been unrelated to adult physical activity (Powell and Dysinger 1987; Sallis, Hovell, Hofstetter 1992).

Determinants for Population Subgroups

Few determinants studies of heterogeneous samples have examined similar sets of characteristics in subgroups. Self-efficacy is the variable with the strongest and most consistent association with physical activity in different subgroups from the same large study sample. Self-efficacy has been positively related to physical activity among men, women, younger adults, older adults (Sallis et al. 1989), Latinos (Hovell et al. 1991), overweight persons (Hovell et al. 1990), and persons with injuries or disabilities (Hofstetter et al. 1991). The generalizability of the self-efficacy associations is extended by studies of university students and alumni (Calfas et al. 1994; Courneya and McAuley 1994; Yordy and Lent 1993), employed

women (Marcus, Pinto, et al. 1994), participants in structured exercise programs (Duncan and McAuley 1993; McAuley, Lox, Duncan 1993; Poag-DuCharme and Brawley 1993), and people with coronary heart disease (CHD) (Robertson and Keller 1992).

Summary

Ideally, theories and models of behavioral and social science could be used to guide research concerning the factors that influence adult physical activity. In actuality, the application of these approaches to determinants research in physical activity has generally been limited to individual and interpersonal theories and models. Social support and some factors from social cognitive theory, such as confidence in one's ability to engage in physical activity (i.e., self-efficacy) and beliefs about the outcome of physical activity, have been consistently related to physical activity among adults. Factors from other theories and models, however, have received mixed support. Although perceptions of the benefits of, and barriers to, physical activity have been consistently related to physical activity among adults, other constructs from the health belief model, such as perceptions of susceptibility to, and the severity of, disease, have not been related to adult physical activity. Further, constructs from the theory of reasoned action and the theory of planned behavior, including intentions and beliefs about the outcomes of behavior, have been consistently related to adult physical activity, whereas there has been equivocal evidence of this relationship for normative beliefs and perceptions of the difficulty of engaging in the behavior. Exercise enjoyment, a determinant that does not derive directly from any of the behavioral theories and models, has been consistently associated with adult physical activity.

Few studies have specifically contrasted physical activity determinants among different sex, age, racial/ethnic, geographic location, or health status subgroups. Many studies contain relatively homogeneous samples of groups, such as young adults, elderly persons, white adults, participants in weight loss groups, members of health clubs, persons with heart disease, and persons with arthritis. Because the numbers of participants in the studies that include these subgroups are small, and because the studies evaluated different factors, making comparisons between studies is problematic.

Interventions to Promote Physical Activity among Adults

This section reviews intervention studies in which the measured outcome was physical activity, adherence to physical activity, or movement in stage of change (Table 6-2). It does not include intervention studies designed to assess the effect of physical activity on health outcomes or risk factors (see Chapter 4). Further, this review places special emphasis on experimental and quasi-experimental studies, which are better able to control the influence of other factors and thus to determine if the outcomes were due to the intervention itself (Weiss 1972).

Individual Approaches

Individual behavioral management approaches, including those derived from learning theories, relapse prevention, stages of change, and social learning theory, have been used with mixed success in numerous intervention studies designed to increase physical activity (Table 6-2). Behavioral management approaches that have been applied include self-monitoring, feedback, reinforcement, contracting, incentives and contests, goal setting, skills training to prevent relapse, behavioral counseling, and prompts or reminders. Applications have been carried out in person, by mail, one-on-one, and in group settings. Typically, researchers have employed these in combination with other behavioral management approaches or with those derived from other theories, such as social support, making it more difficult to ascertain their specific effects. In numerous instances, physical activity was only one of several behaviors addressed in an intervention, which also makes it difficult to determine the extent that physical activity was emphasized as an intervention component relative to other components.

Self-monitoring of physical activity behavior has been one of the most frequently employed behavioral management techniques. Typically, it has involved individuals keeping written records of their physical activity, such as number of episodes per week, time spent per episode, and feelings during exercising. In one study, women who joined a health club were randomly assigned to a control condition or one of two intervention conditions—self-monitoring of attendance or self-monitoring plus extra staff attention (Weber and Wertheim 1989). Overall, women in the

Table 6-2. Studies of interventions to increase physical activity among adults

Study	Design	Theoretical approach	Population
Individual approaches			
Weber and Wertheim (1989)	3 month experimental	Self-monitoring	55 women who joined a gym; mean age = 27
King, Haskell, et al. (1995)	2 year experimental	Behavioral management	269 white adults aged 50–65 years
Lombard, Lombard, Winett (1995)	24 week experimental	Stages of change	155 university faculty and staff; mostly women
Cardinal and Sachs (1995)	12 week experimental	Stages of change	113 clerical staff at a university; mean age = 37; 63% black
Belisle (1987)	10 week quasi-experimental with 3-month follow-up	Relapse prevention	350 people enrolled in beginning exercise groups
Gossard et al. (1986)	12 week experimental	Behavioral management	64 overweight healthy men aged 40–60 years
King, Carl, et al. (1988)	16 week pretest-posttest	Behavioral management	38 blue-collar university employees; mean age = 45
King and Frederiksen (1984)	3 month experimental	Relapse prevention, social support, behavioral management	58 college women aged 18–20 years
King, Taylor, et al. (1988)	Study 1: 6 month experimental	Relapse prevention, behavioral management	152 Lockheed employees aged 42–55 years
	Study 2: 6 month experimental	Behavioral management	Lockheed employees from Study 1

I = intervention; C = control or comparison group.

Intervention	Findings and comments
I-1: Self-monitoring of attendance, fitness exam I-2: Self-monitoring, staff attention, fitness exam C: Fitness exam	I-1 had better attendance than I-2 overall; interest in self-monitoring waned after 4 weeks
I-1: Self-monitoring, telephone contact, vigorous exercise at home I-2: Self-monitoring, telephone contact, moderate exercise at home I-3: Self-monitoring, vigorous exercise in group	Better exercise adherence at 1 year in home-based groups; at year 2 better adherence in vigorous home-based group; 5 times per week schedule may have been difficult to follow
I-1: Weekly calls, general inquiry I-2: Weekly calls, structured inquiry I-3: Call every 3 weeks, general inquiry I-4: Call every 3 weeks, structured inquiry	Frequent call conditions had 63% walking compared with 26% and 22% in the infrequent condition; frequent call and structured inquiry had higher rate of walking than other groups
I-1: Mail-delivered lifestyle packet based on stages of change I-2: Mail-delivered structured exercise packet with exercise prescription C: Mail-delivered fitness feedback packet	No difference in stage of change status among or within groups
I: Exercise class and relapse prevention training C: Exercise class results across experimental groups	Higher attendance in relapse prevention group over 10 weeks and at 3 months; high attrition and inconsistent
I-1: Vigorous self-directed exercise, staff telephone calls, self-monitoring I-2: Moderate self-directed exercise, staff telephone calls, self-monitoring C: Staff telephone calls	Better adherence in the moderate-intensity group at 12 weeks compared with vigorous (96% vs. 90%) (no statistical tests reported); travel, work schedule conflicts, and weather were noted as barriers to physical activity
I: 90-minute classes 2 times/week after work, parcourse, self-monitoring, contests C: None	Twofold increase in bouts of exercise compared with nonparticipants. Participants different from nonparticipants at baseline
I-1: Team building, relapse prevention training; group exercise I-2: Team building, group exercise I-3: Relapse prevention training and jogging alone C: Jogging alone	I-2 and I-3 had twice the jogging episodes as I-1 and C at 5 weeks; at 3 months, 83% of I-3 were jogging compared with 38% of I-1 and I-2 and 36% of C
I-1: Home-based moderate exercise, self-monitoring with portable monitor, relapse prevention training, telephone calls from staff I-2: Same as I-1 without telephone calls from staff	No difference in number of sessions and duration reported at 6-month follow-up
I-1: Daily self-monitoring I-2: Weekly self-monitoring	I-1 had more exercise bouts per month (11 vs. 7.5)

Table 6-2. *Continued*

Study	Design	Theoretical approach	Population
Marcus and Stanton (1993)	18 week experimental	Relapse prevention, social learning theory	120 female university employees, mean age = 35
McAuley et al. (1994)	5 month experimental	Social learning theory	114 sedentary middle-aged adults
Owen et al. (1987)	12 week quasi-experimental	Behavioral management	343 white-collar and professional workers, mean age = 36, mostly women
Robison et al. (1992)	6 month quasi-experimental	Behavioral management, social support	137 university staff at 6 campus worksites, mean age = 40
Interventions in health care settings			
Logsdon, Lazaro, Meier (1989) (INSURE)	1 year quasi-experimental	None mentioned	2,218 patients from multi-specialty group practice sites
Calfas et al. (in press)	2 week quasi-experimental	Stage of change	212 patients
Community approaches			
Luepker et al. (1994) (Minnesota Heart Health Project)	5 to 6 year quasi-experimental; 3 matchedpairs	Diffusion of innovations, social learning theory, community organization, communication theory	Community longitudinal cohort (n = 7,097), independent survey (n = 300–500)
Young et al. (in press) (Stanford Five-City Project)	7 year quasi-experimental	Social learning theory, communication theory, community organization	2 sets of paired, medium-sized cities (5th city used for surveillance only)
Macera et al. (1995)	4 year quasi-experimental (2 matched communities)	None specified	Community residents ≥ 18 years; 24% African American (I), 35% African American (C)
Brownson et al. (1996)	4 year quasi-experimental	Social learning theory, stage theory of innovation	Rural communities; largely African American

I = intervention; C = control or comparison group.

Intervention	Findings and comments
I-1: Relapse prevention training and exercise I-2: Scheduled reinforcement for attendance and exercise C: Exercise only	Better attendance in I-1 at 9 weeks; no difference at 18 weeks or 2-month follow-up
I: Modeling of exercise, provision of efficacy-based information (mastery accomplishments, social modeling, social persuasion, physiological response), walking program C: Biweekly meetings on health information, walking program	Better class attendance (67% vs. 55%) and more minutes and miles walked among intervention group than controls
I: Self-management instruction, exercise class C: Exercise class	No difference in activity levels at 6 months
I: Weekly group meetings, contracts, cash incentives, social support, exercise C: Exercise, diary	Higher attendance among experimental groups than comparison groups (93–99% vs. 19%)
I: Screening and counseling from physicians who received continuing education; preventive visits at no charge	Increase in starting to exercise among intervention patients (34% to 24%)
I: Physician counseling; booster call from a health educator C: Nothing	Intervention patients increased walking (37 minutes vs. 10 minutes per week)
I: Screening and education; mass media; community participation; environmental change; professional education; youth and adults C: Nothing	Percent physically active higher in independent survey at 3 years; higher in the cohort at 7 years
I: Print materials; workshops and seminars; organized walking; organized walking events; "Heart & Sole" groups; worksite programs; TV spots	Men increased participation in vigorous activities; men and women in the intervention communities increased their overall number of physical activities; significant differences between intervention and comparison communities at baseline
I: Community cardiovascular risk reduction activities C: None specified	No difference in physical activity prevalence, physican counseling for exercise, or exercise knowledge
I: Community organization; development of 6 coalitions; exercise classes and walking classes and walking clubs; demonstrations; sermons; newspaper articles; community improvements; $5,000 to each coalition from the state health department	Increased physical activity levels in coalition communities, declining levels in communities without; net effect was 7%. Planned Approach to Community Health education planning model

Table 6-2. *Continued*

Study	Design	Theoretical approach	Population
Marcus, Banspach, et al. (1992) (Pawtucket Heart Health Program: Imagine Action)	6 week pretest-posttest uncontrolled	Stages of change	610 sample of community residents, mean age = 42
Worksites			
Blair et al. (1986) (Live for Life)	2 year quasi-experimental	None	4,300 Johnson & Johnson employees
Fries et al. (1993)	24 month experimental	None	4,712 Bank of America retirees
Heirich et al. (1993)	3 year experimental	None specified	1,300 automobile plant workers
Communication			
Osler and Jespersen (1993)	2 year quasi-experimental	Social learning theory, communications (diffusion of innovations); community organization	Rural communities in Denmark (n = 8,000 [I])
Owen et al. (1995)	2 year pretest-posttest	Social learning theory, social marketing theory	2 national physical activity campaigns in Australia
Brownell, Stunkard, Albaum (1980)	Study 1: 8 week quasi-experimental	None specified	21,091 general public observations at a mall, train station, bus terminal
	Study 2: 4 month quasi-experimental	None specified	24,603 general public observations at a train station
Blamey, Mutrie, Aitchison (1995)	16 week quasi-experimental	None	22,275 subway users observations

I = intervention; C = control or comparison group.

Intervention	Findings and comments
Written materials, resource manual, weekly fun walks, and activity nights	Participants more active after intervention with movement toward action and low relapse to earlier stage; suggests stage-based community intervention can result in movement toward action; study uncontrolled
I: Screening; lifestyle seminar; exercise programs; newsletters; contests; health communications; no smoking policies C: Screening only	20% of women and 30% of men began vigorous exercise of 2 years
I-1: Health risk appraisal; feedback letter; behavioral management materials; personalized health promotion program I-2: Health risk appraisal; no feedback; full program in year 2 C: No intervention	No difference in physical activity year 1; I-1 greater physical activity in year 2 over I-2
I-1: Fitness facility I-2: Outreach and counseling to high risk employees I-3: Outreach and counseling to all employees C: Health education events	Percent exercising 3 times per week: I-1 = 30%, , I-2 = 44%, I-3 = 45%, C = 37%
I: Heart Week with assessments, health education, weekly community exercise, TV, radio, newspaper community messages C: Not specified	No difference in self-reported physical activity, but intervention community expressed more interest in becoming active; low response rate to surveys (59%); became mainly a media campaign with little community involvement
I: Messages to promote walking and readiness to become active; modeling activity; radio and TV PSAs; T-shirts; special scripting of soap operas	1st campaign—increase in percent who walked for exercise (70% to 74%), greatest impact on 50+ age group (twofold increase in reported walking—not significant) 2nd campaign—small declines in reported walking and in intentions to be more active
I: Sign reading "Your heart needs exercise—here's your chance"	Number of people using the stairs increased from 5% to 14% when sign was up. Use declined to 7% when sign was removed
I: Sign reading "Your heart needs exercise—here's your chance"	Number of people using the stairs increased from 12% to 18%; effect remained for 1 month after sign was removed
I: Sign reading "Stay Healthy, Save Time, Use the Stairs"	Baseline stair use increased to 15–17% when sign was up; persisted at 12 weeks after sign removal; larger increase among men

Table 6-2. *Continued*

Study	Design	Theoretical approach	Population
Special populations: ethnic minorities			
Heath et al. (1991)	2 year quasi-experimental	None specified	86 Native Americans with diabetes
Lewis et al. (1993)	3 year quasi-experimental	Constituency-based model	African American residents of 6 public housing units
Nader et al. (1989) (San Diego Family Health Project)	3 month experimental 9 month maintenance	Social learning theory	623 Mexican and Anglo-American families with 5th grade children
Baranowski et al. (1990)	14 weeks	None specified	94 black families (63 adults, 64 children)
Special populations: persons at risk for chronic disease			
Perri et al. (1988)	18 month experimental	Behavioral management	123 overweight adults
Jeffery (1995)	7 year uncontrolled	None mentioned	280 community members trying to lose weight
King et al. (1989)	2 year experimental	None mentioned	96 men trying to maintain weight loss
Special Populations: older adults			
Mayer et al. (1994)	2 year experimental	Social learning theory	1,800 Medicare beneficiaries in HMO, mostly white, high SES

I = intervention; C = control or comparison group.

Intervention	Findings and comments
I: Exercise class C: Nonparticipants	Participants in the exercise program lost 4 kg of weight on average, compared with 0.9 kg among nonparticipants; improvements occurred in fasting blood glucose levels and medication requirements
I-1: Basic exercise program I-2: Basic exercise program; social; goal setting; attention; information; barrier reduction	Communities that were better organized and had more committed leaders had better program attendance and higher physical activity levels
I: Family newsletter; telephone; mail; personal contact; feedback; family behavior management; physical activity; nutrition education C: Periodic evaluation	No difference in physical activity at 1 year
I: Individual counseling, small group education, aerobic activity, incentives (babysitting, transportation), telephone prompts, assessment C: Assessment only	No difference in energy expenditure; low participation (20%)
I-1: Behavior therapy I-2: Behavior therapy, maintenance I-3: Behavior therapy, maintenance, social influence I-4: Behavior therapy, maintenance, exercise I-5: Behavior therapy, maintenance, exercise, social influence	Difference adherence in high exercise groups at 6 months; no differences at 12 and 18 months; high attrition (24%)
I-1: Diet management I-2: Weight management, including exercise I-3: Physical activity	I-2 resulted in greater weight loss at end, but no differences were observed at 1 year
I: Monthly mailings, advice and tips for coping, staff telephone calls C: No intervention	Men who exercised and received the intervention regained less weight in year 2 than exercisers who did not get the intervention or dieters who were exposed to the intervention
I: Health risk appraisal, feedback, health education sessions, medical tests, immunizations, goal setting, self-monitoring C: Not specified	No change in physical activity (3+ times a week) at 1 year, but 21% vs.14% moved from sedentary to active (no statistical test reported); attrition 16% in experimental group at 1 year